Welcome to WIPAC

IceCube Madison BootCamp 2017

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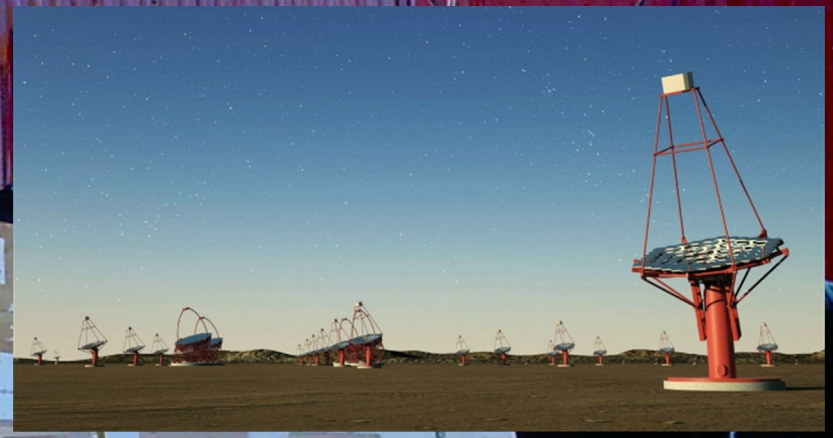
WIPAC – the Mission

I. Educate and train future leaders in particle astrophysics through a vibrant science program.
II. Operate the IceCube Neutrino Observatory in partnership with the international collaboration and extract scientific results from the data collected.
III. Advance scientific opportunities by supporting the design, construction, and operation of a wide platform of experiments.
IV. Provide expertise and resources for the development of innovative instrumentation.
V. Engage the public and students of all ages in scientific progress through education and outreach programs and activities.

Category	Count
Technical and Administrative Staff	46
Faculty	5
Grad Students	22
PostDocs	9
Undergrads	22
Total	**104**

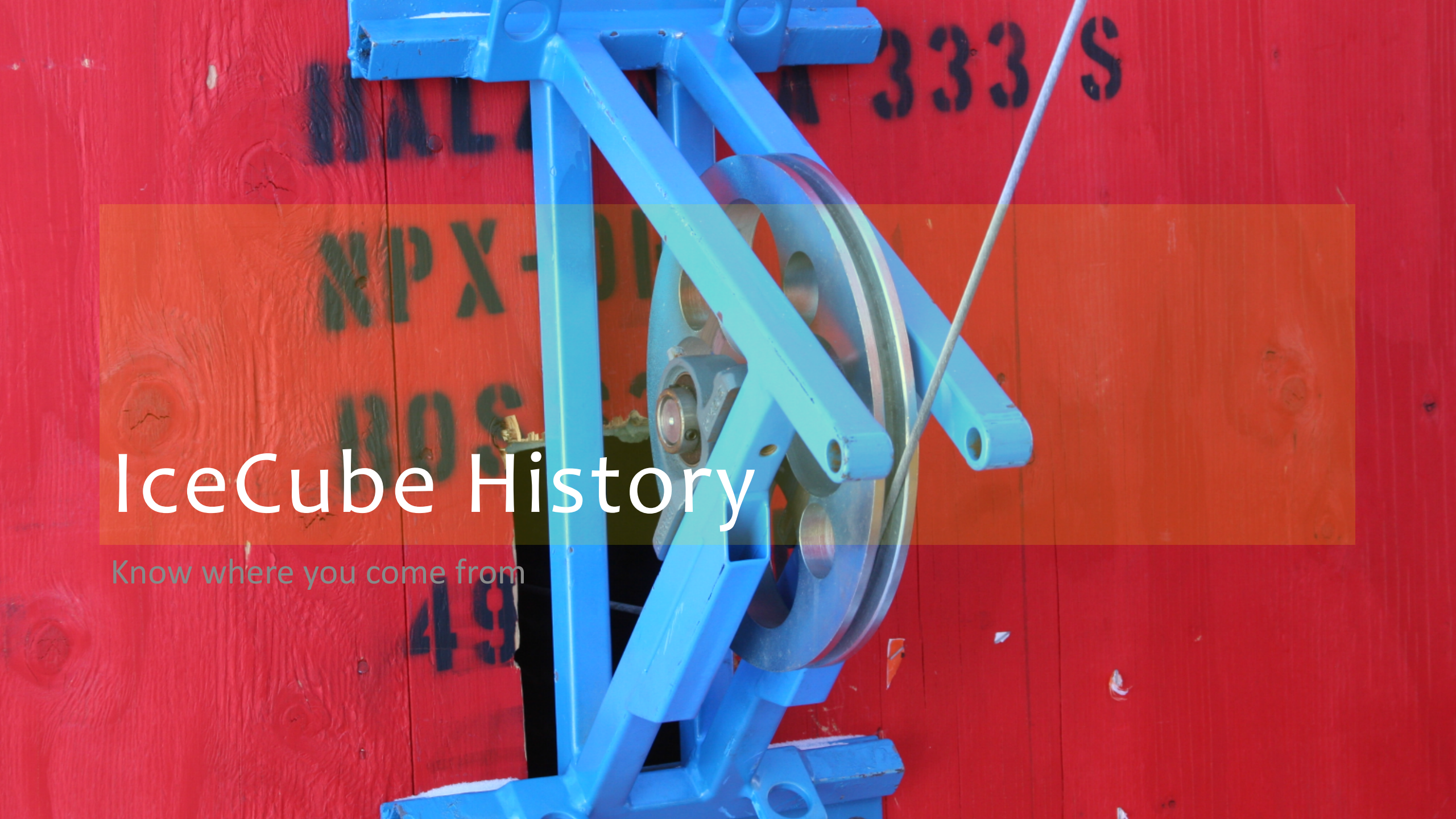
Services Provided

- IceCube Maintenance & Operations
  - IT services for the Collaboration: operation of 2 computing clusters with total of 2000 CPU cores, >250 GPU cores, and > 5 PB of online storage.
  - Daily operations of the IceCube detector including training and supervision of Winter-overs.
  - Centralization of mass data filtering and simulation production.
  - Management of the NSF CA including administration of sub-awards and annual reviews.
  - IceCube (and general) public relations and broader impacts.
  - On-going initiatives: DOM calibration (Ch. Wendt)
  - New initiatives: scintillator panel deployment for snow mitigation
- Advancing the scientific field: support science and engineering for ARA, HAWC, CTA, DM-Ice, Future IceCube (Gen2/Phase 1), CHIPS, and other initiatives.
- Training next-generation of scientists: Bahcall Fellowship program offers post-doctoral researchers opportunity to work on IceCube and autonomy pursue their own research interests.
- Our visitor program attracts world-class researchers to work with the WIPAC team for extended periods – current visitor is David Seckel of University of Delaware



IceCube Help Wanted

- Why do we run these boot camps? Because we need YOU!
- IceCube relies on the scientific and technical input (ideas, data analysis, code, and more) of the entire collaboration to achieve its goals.
- How can you help?
  - Finish your thesis – do a great analysis, defend it, and publish.
  - Give back to your IceCube peers – we all need to contribute effort to make IceCube a better system. Maybe this is directly related to your research and maybe it is not.
    - Write great software and/or work on infrastructure : get plugged into S/W development.
    - Help with understanding the detector.
    - Think of new ideas for enhancing IceCube.
  - Mentor the students coming in behind you.
  - Bring IceCube to the world: have a broad impact on the science community and the general population. People are really interested in what you are doing!
- Consider spending *an entire year at South Pole* (a.k.a. Winter-Over).

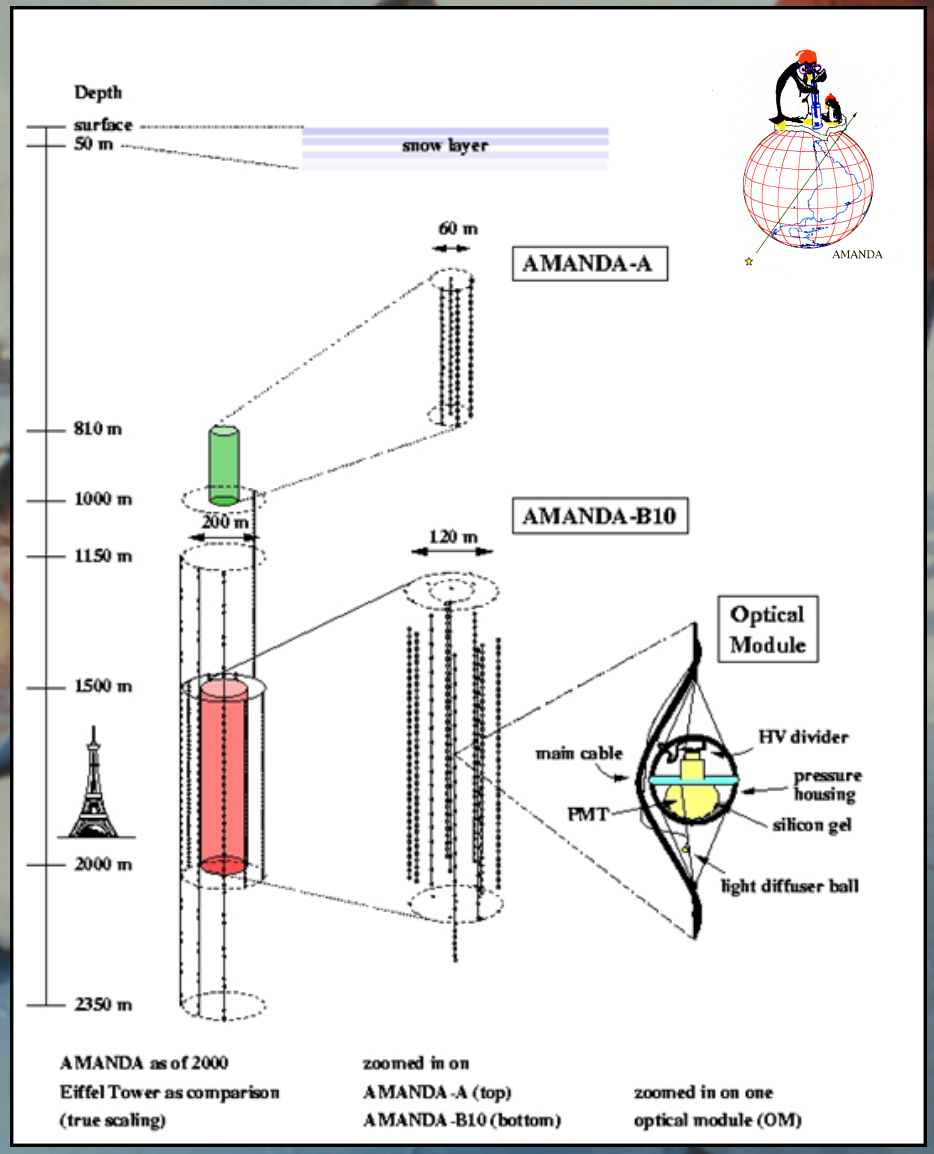


IceCube History

Know where you come from

First there was AMANDA

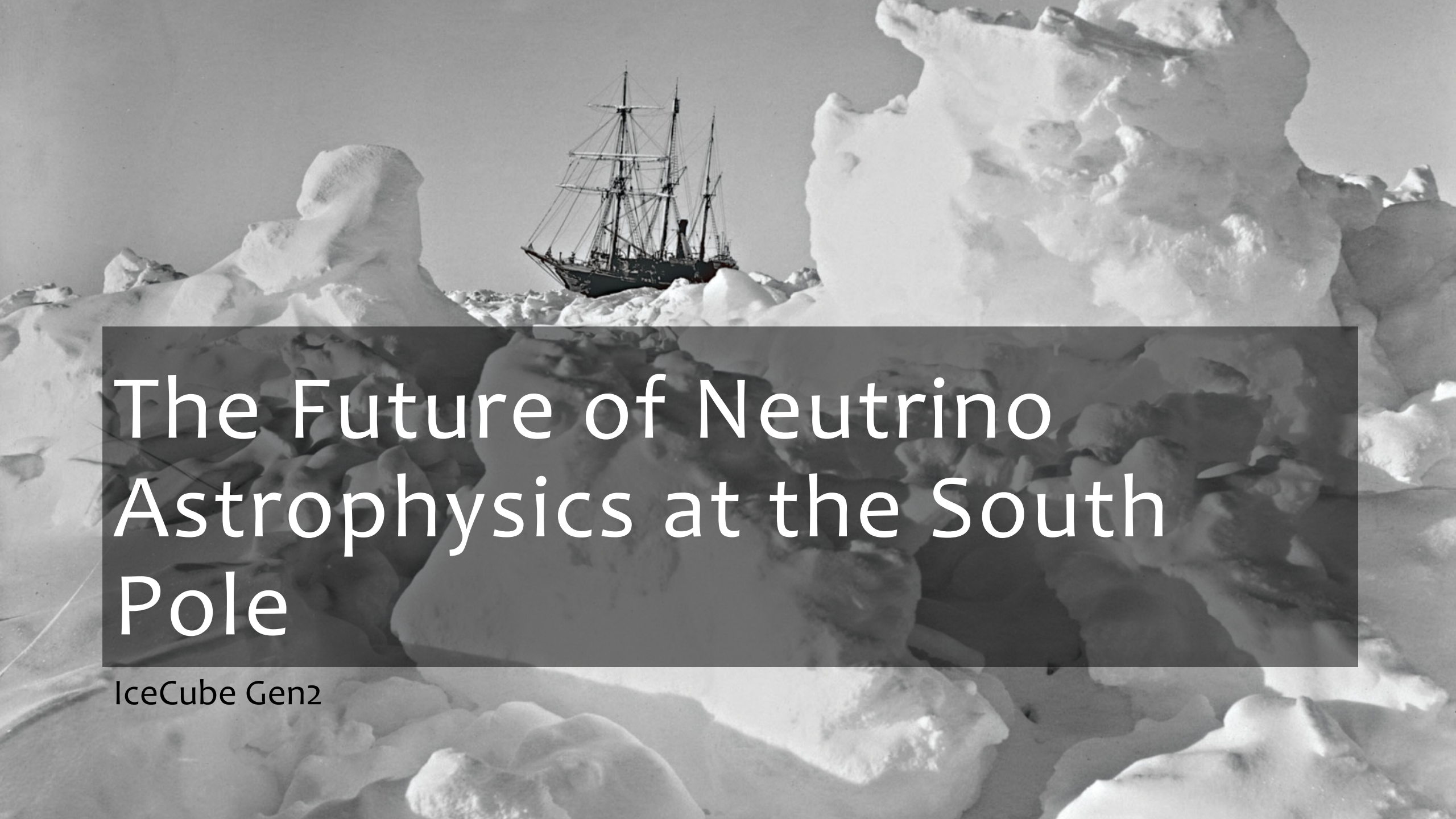
- What can I say? It was a different world back then …
- In addition to the different social dynamic of the collaboration,
- The AMANDA modules were ANALOG!
  - Extremely high gain (10^9) 12-stage 8” PMTs directly driving 2 km cables.
  - Pulses were SLOOOOOOW and we used CAMAC instrumentation to digitize the peak ADC and the ToT
    - Ah yes and there was crosstalk …
- Strings 11-19 had optical fibers but they broke about 20% of the time.
- Then there was String 18 …
- Oh yes, and String 17 was stuck
- And we had to re-calibrate all timing offsets each year using a really painful procedure.



One of a handful of non X-rated pictures from the AMANDA days

IceCube: the Optimized Production Version

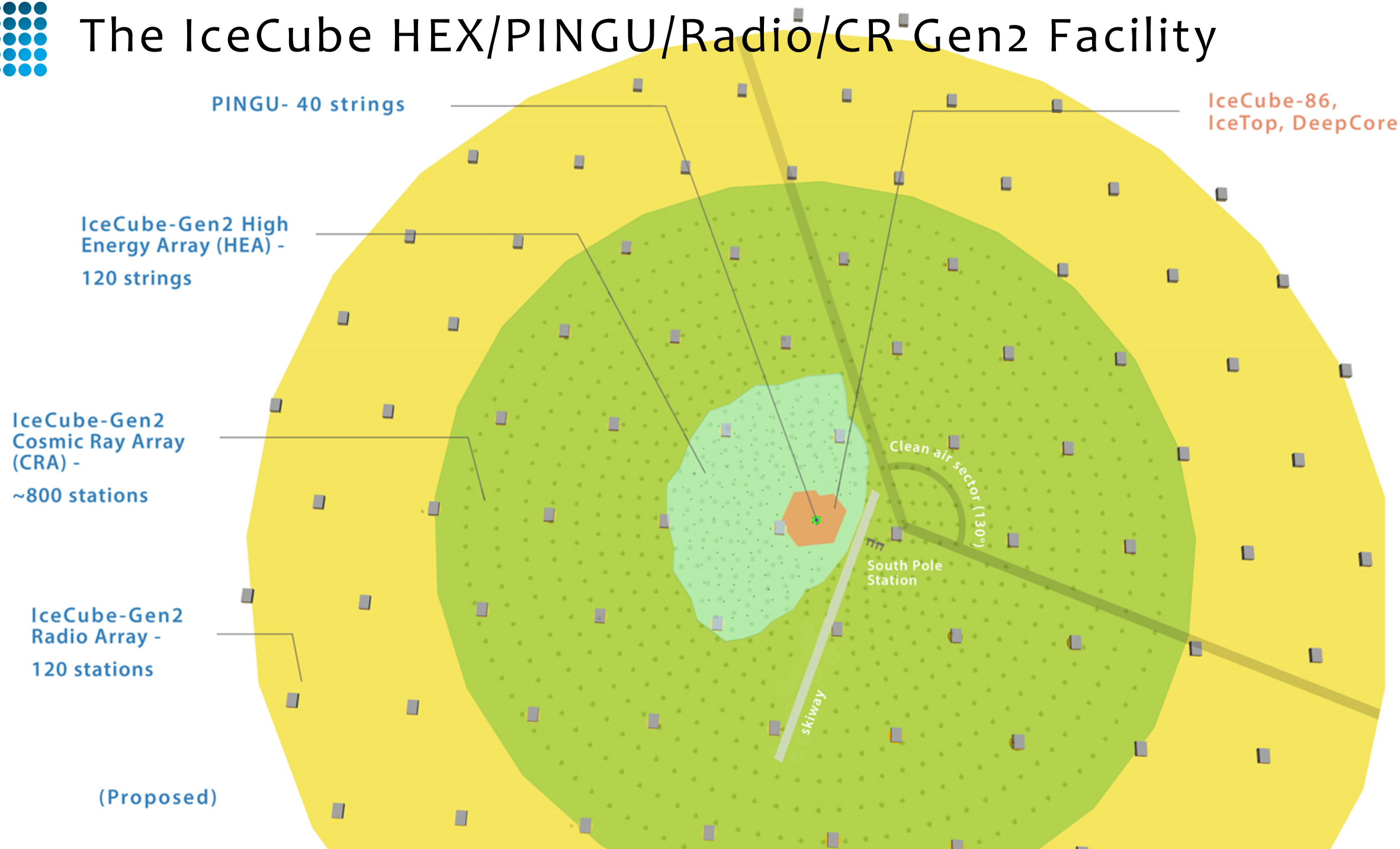
- The basic design of AMANDA was good but …
- Scaling to >5000 channels we realized that something had to be done. The single charge measurement of AMANDA hurt reconstructions, but the maintenance issue was the real show stopper – IceCube had to be a detector which could deliver the science *and* be operated.
- Then there was the small matter of getting 300 million dollars.
- IceCube trivia: the first two IceCube-style DOMs deployed were called *Frankendom* (it died but came back to life) and *Scarface* (the glass sphere had obvious shearing marks on it) and were deployed in 2003-2004 at the surface in an early shipment to Pole (along with some Snickers bars). They probably still would work …
- We had to ramp up quickly and learn a lot about the mid-scale production environment – by Fall 2004 we had 400 DOMs all tested and ready to ship to Pole.
- Over the next 6 years 3 production sites (UW, DESY-Z, Sweden) would furnish the remaining 5000 modules. And now … look where we are!
- And then of course there was the hot water drill: PSL (Stoughton, WI) designed, produced, and operated the 4.5 MW device from 2002 – 2010. Pieces of it still live and may be revived to drill again.



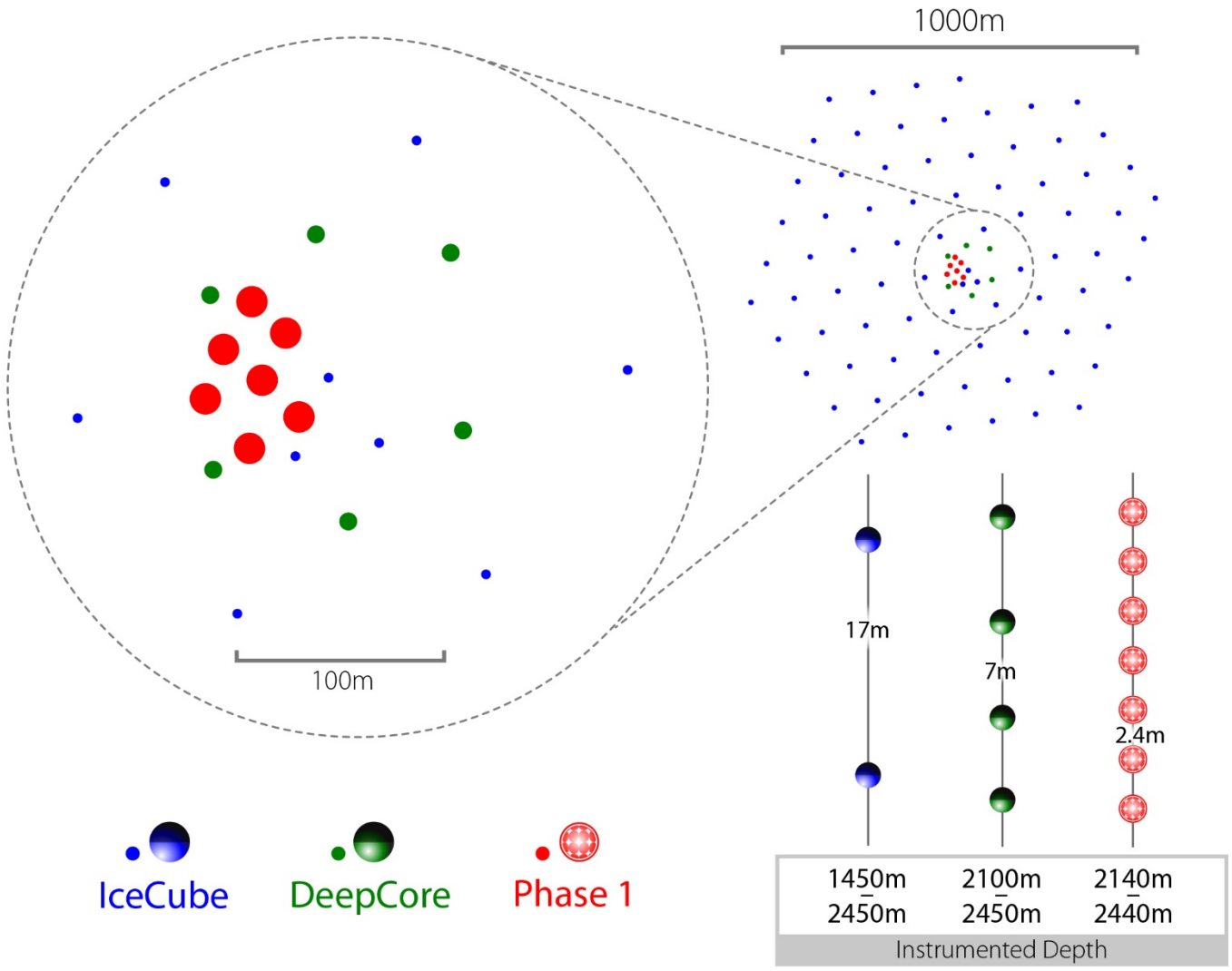
The Future of Neutrino Astrophysics at the South Pole

IceCube Gen2

The IceCube HEX/PINGU/Radio/CR Gen2 Facility



But first Gen2 Phase 1



Science Targets

- Nu tau normalization from atmospheric neutrino beam to probe PMNS unitarity
- Neutrino oscillation parameters
- Astrophysical nu tau / flavor physics
- Improved ice modeling for IceCube – reduce systematics, improve reconstruction, retroactively applicable to 10+ years of IceCube data on disk
- Pave wave for Gen2 drilling and logistics.

Send-off

- OK, enough said – the interesting techinal download now begins
- You will enrich not only your IceCube-specific toolbox but also get tutorials on using general Python / NumPy / SciPy / Matplotlib and statistics.
- Cram as much as you can into this week – there is a lot of material to cover and the experts are here.
- The weather this week is going to be exceptionally warm – take advantage of some cool hangouts such as the Terrace and enjoy the lake view.